Remarks

In view of the above amendments and the following remarks, reconsideration of the rejections and further examination are requested.

Claim 11 has been objected to as having two identifiers. Although claim 11 has been canceled without prejudice or disclaimer to the subject matter contained therein, it is noted that 37 CFR 1.121 (c)(2) provides for the use of two identifiers in the situation where a withdrawn claim is being amended, as was the case with claim 11. Therefore, it is noted that a claim having two identifiers is not per se improper.

Claims 1, 6 and 10 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Seto (US 2003/0035183) in view of Franco (US 2004/0190911). Claim 8 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Seto in view of Franco and further in view of Way (US 6,525,857). Claim 9 has been rejected under 35 U.S.C. §103(a) as being unpatentable over Seto in view of Franco and further in view of Ooi (US 6,362,913).

Claims 1, 6 and 8-11 have been canceled without prejudice or disclaimer to the subject matter contained therein.

Further, new claims 20-23 have been added. It is submitted that the above-mentioned rejections are inapplicable to the new claims for the following reasons.

Claim 20 is patentable over the combination of Seto and Franco, since claim 1 recites an optical transmission apparatus for transmitting an optical signal via an optical fiber to a radio base station which photoelectrically converts the optical signal into a radio signal having a predetermined frequency and transmits the radio signal to a subscriber terminal, the optical transmission apparatus including an electrical-optical converter operable to convert an intermediate frequency signal into an optical signal by intensity-modulation; a local oscillation signal source operable to output a local oscillation signal; and an external modulator operable to intensity-modulate the optical signal using the local oscillation signal to produce an intensity-modulated optical signal, wherein an intensity-modulation component of the intensity modulated optical signal has a frequency component of the radio signal. The combination of Seto and Franco fails to disclose or suggest these features of claim 20.

As recited in claim 20, the present invention is directed to an optical transmission apparatus for a radio system, the optical transmission apparatus for transmitting an optical signal to a radio base station. The radio base station, in turn, converts the optical signal transmitted

from the optical transmission apparatus into a radio signal, and transmits the radio signal to a subscriber terminal.

Seto discloses an optical communication system including a transmitting/receiving station 10B connected to a number of transmitting/receiving devices 32B-1-32B-P by an optical fiber 30. The station 10B includes modulators 12-1-12-P, frequency converters 88-1-88-P, pilot carrier generators 14-1 and 14-2, an adder 16 and an electrical/optical converter 18. The modulators 12-1-12-P output signals modulated with data input thereto to the frequency converters 88-1-88-P, respectively. The frequency converters 88-1-88-P frequency convert the modulated input signals and output the frequency converted signals to the adder 16. The adder 16 adds the frequency converted signals together with pilot carrier signals f_{LO1} and f_{LO2} from the pilot carrier generators 14-1 and 14-2 and outputs a synthesized signal to the converter 18. The converter 18 outputs a laser beam optically modulated in accordance with the synthesized signal to an optical divider 34 for transmission to the devices 32B-1-32B-P via the optical fiber 30. (See page 13, paragraphs [0196] – [0206] and Figure 15).

Based on the above discussion, it is apparent that Seto discloses that the modulators 12 output signals modulated with a plurality of data signals which are added to the pilot carrier signal by the adder 16. The sum signal from the adder 16 is then electro-optically converted into an optical signal by the electro-optical converter 18, and the optical signal is transmitted to the devices 32B, where it is up-converted into a radio signal having a desired frequency. Therefore, the invention of Seto enables a reduction in the number of pilot carrier signals, which must be equal to the number of data signals to be transmitted in the conventional art.

Further, in Seto, the frequency arrangement for the pilot carrier signal is designed such that the devices 32B can easily extract the pilot carrier signal. Accordingly, the pilot carrier signal is indispensable to each of the devices 32B for up-converting an electrical signal obtained by photoelectric conversion via an O/E converter 34 into a signal having a desired frequency. That is, the devices 32B each must up-convert the electrical signal obtained by the photoelectric conversion. Therefore, the transmitting/receiving station 10B adds the data signal to the pilot carrier signal using the adder 16, and thereafter, converts the sum signal into the optical signal using electro-optical converter 18 and transmits the optical signal.

On the other hand, a first object of the present invention is to optically transmit a data signal of high quality. Further, a second object of the present invention is to solve the problem of

Seto, that is, to eliminate the need to up-convert the electrical signal at the devices 32B. The first and second objects can be simultaneously attained in the present invention.

To attain the first object, an intermediate signal is converted into an optical signal by intensity-modulation (direct modulation) which enables the optical signal to be transmitted with low distortion. Further, the second object is obtained by performing intensity-modulation (external modulation) following the direct modulation. In the external modulation, the optical signal obtained by the direct modulation is subjected to intensity modulation using a local oscillation signal. This corresponds to multiplying a frequency of the intermediate frequency signal by a frequency of the local oscillation signal. The obtained intensity-modulated component of the optical signal contains a desired radio signal frequency component.

The local oscillation signal of the present invention is different from the pilot carrier signal indispensable to the devices 32B of Seto. The local oscillation signal is for the transmitting device to optically convert a frequency, and is not required by the receiving device. Therefore, the modulation performed using the local oscillation signal increases the generation of distortion components as compared to direct modulation. However, the modulation performed using the local oscillation signal is advantageous in that the external modulator can be used, which is lower in cost as compared to the directly-modulating device.

Based on the above discussion, it is apparent that Sato fails to disclose or suggest the features recited in claim 20. Therefore, Franco must necessarily disclose or suggest these features in order for the combination of Sato and Franco to render claim 1 obvious.

Franco discloses a transmission apparatus including a laser 1, a first amplitude modulator 2 and a second amplitude modulator 12. The first amplitude modulator 2 is driven by a composite electrical signal including a first periodic electrical signal 4, a second periodic electrical signal 5 at the second harmonic of the first periodic electrical signal 4, and a third periodic electrical signal 6 at a higher harmonic of the first periodic electrical signal 4, and emits a pulsed modulated optical signal to the second amplitude modulator 12. The second amplitude modulator 12 is driven by an electrical signal 13 containing the data to be transmitted and emits a pulsed transmission signal to transmit the data. (See page 4, paragraph [0086] – [0097] and Figure 1).

However, it is respectfully submitted that Sato and Franco cannot be properly combined to disclose the present invention despite the comments provided in the "Response to the Arguments" section of the outstanding Office Action.

In the "Response to the Arguments" section, it is asserted that Franco can be relied upon as teaching that: the pilot carrier signal modulation of Seto could be modified such that the pilot signals are not combined electrically with the data signals; the electric-optic conversion of Seto could be subjected to only the data signals using the laser; and the pilot carrier signals of Seto could modulate the optical signal output from the laser using an external modulator. However, it is submitted that Seto could not be modified in this manner and operate properly for the following reasons.

Regarding the indication that the pilot carrier signal modulation of Seto could be modified such that the pilot signals are not combined electrically with the data signal, it is noted that, according to Seto, the pilot carrier signal is indispensable to the devices 32B. Therefore, the intermediate frequency signal is added to the pilot carrier signal and transmitted. This contradicts the Examiner's assertion that "the pilot carrier modulation of Seto could be modified such that the pilot signals are not combined electrically with the data signals." Further, Seto and Franco both fail to disclose or suggest that such a modification could be performed.

Regarding the indication that the electric-optic conversion of Seto could be subjected to only the data signals using the laser, this is also not supported by Seto or Franco. That is, Seto and Franco both fail to disclose or suggest that only the data signal is optically modulated.

Regarding the indication that the pilot carrier signals of Seto could modulate the optical signal output from the laser using an external modulator, there is nothing in Seto or Franco that discloses or suggests that the external modulator of Franco could be provided following the laser of Seto, and further, that the pilot carrier signal is used for the modulation performed by the external modulator. According to Franco, double external modulations are performed for waveform-shaping an optical signal to be transmitted. That is, an external modulator is connected as a series device. Therefore, the present invention as recited in claim 20 in which double optical modulations are performed by performing both the direct optical modulation and the external optical modulation cannot be arrived at by combining Franco and Seto.

In light of the above discussion, it is apparent that it would not have been obvious to a person of ordinary skill in the art to combine Seto and Franco in a manner to disclose or suggest the present invention as recited in claim 20.

As for Way and Ooi, they are relied upon as disclosing a modulator that produces a single sideband signal and characteristics of a Mach-Zehner type modulator, respectively. However, neither of these references discloses or suggests the above-discussed features of claim 20.

Because of the above-mentioned distinctions, it is believed clear that claims 20-23 are allowable over the references relied upon in the above-mentioned rejections. Furthermore, it is submitted that the distinctions are such that a person having ordinary skill in the art at the time of invention would not have been motivated to make any combination of the references of record in such a manner as to result in, or otherwise render obvious, the present invention as recited in claims 20-23. Therefore, it is submitted that claims 20-23 are clearly allowable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance. The Examiner is invited to contact the undersigned by telephone if it is felt that there are issues remaining which must be resolved before allowance of the application.

Respectfully submitted,

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